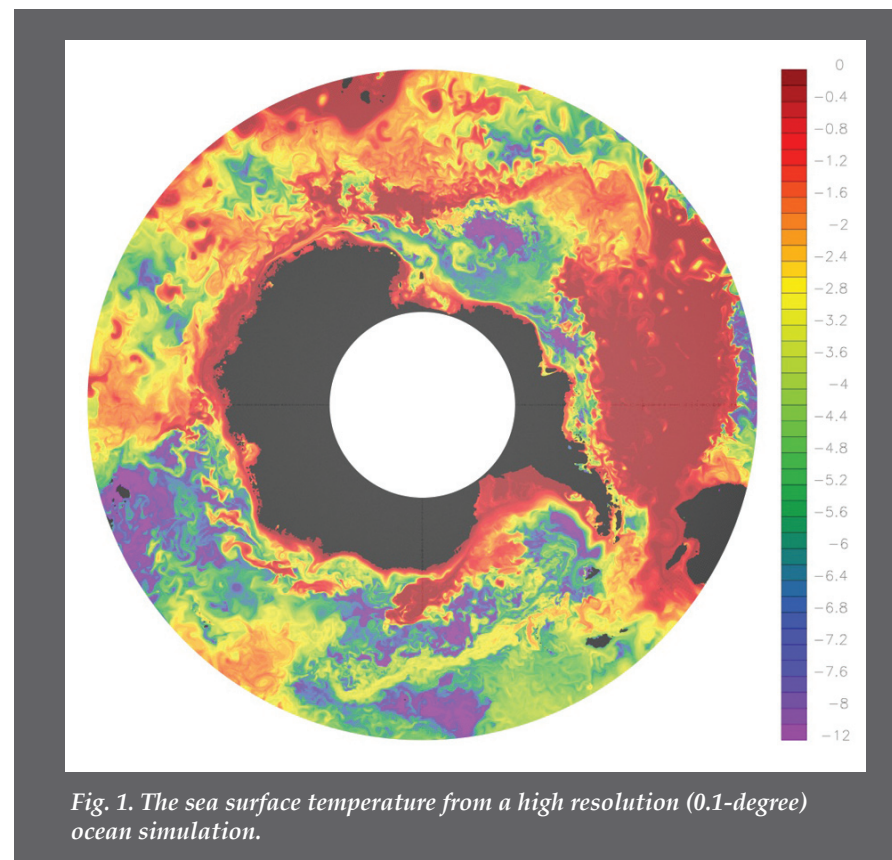


## Climate, Ocean, and Sea Ice Modeling

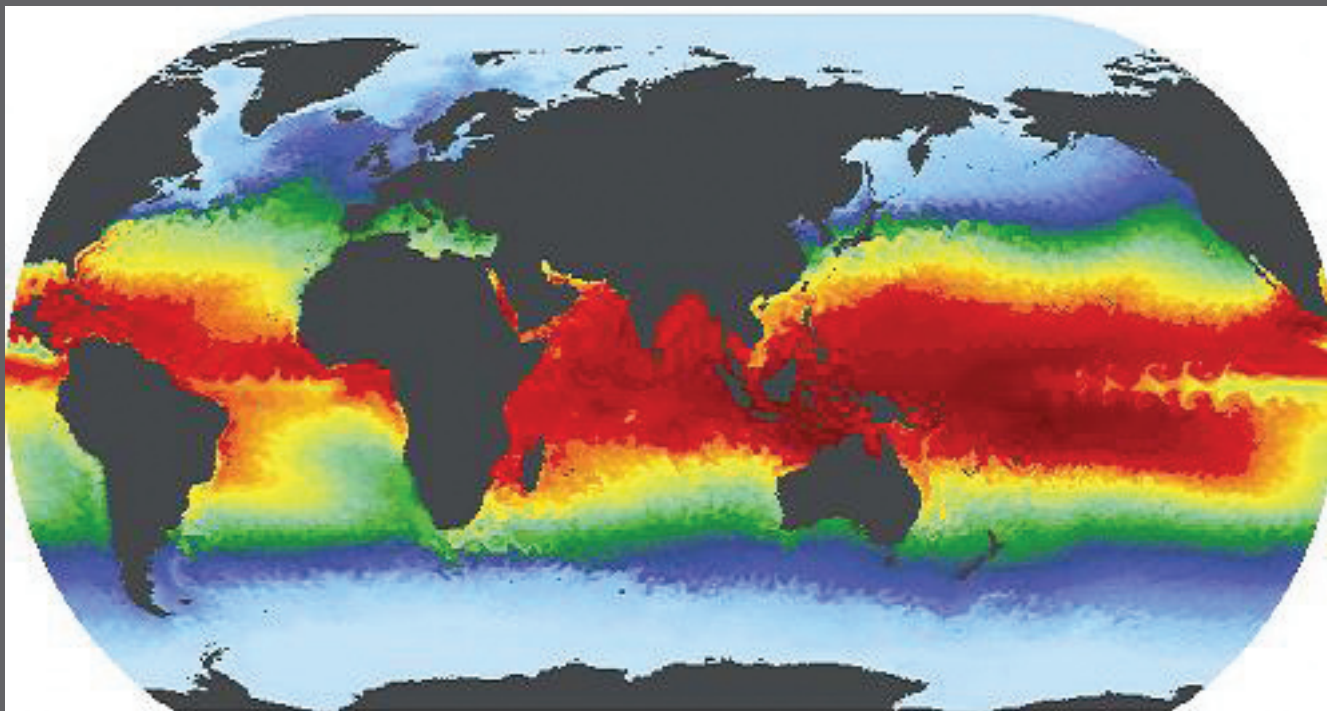
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The Climate, Ocean, and Sea Ice Modeling (COSIM) project develops and maintains advanced numerical models of the ocean and sea ice for use in global climate change projections. COSIM models were used extensively in simulations for the recent climate assessment assembled by the Intergovernmental Panel on Climate Change (IPCC) that was awarded the 2007 Nobel Peace Prize. The flagship Parallel Ocean Program (POP) and Community Ice CodE (CICE) are the ocean and sea ice components of the Community Climate System Model that contributed the largest number of simulations to the recent IPCC assessment, and are used by a large number of climate scientists worldwide. In addition to ocean and sea ice models, COSIM scientists are working on new ice sheet models to more accurately simulate and predict the fate of large ice sheets covering Greenland and West Antarctica. Ocean ecosystems and their impacts on the carbon and sulfur cycles have been another important addition to the physical models.

While the emphasis is on developing ocean and ice models for the climate community, COSIM researchers also use the models to address scientific issues. Of particular interest over the past several years has been the impact of ocean eddies on the global ocean circulation. Ocean mesoscale eddies are about 20 km in size, and resolving these eddies requires the highest-resolution ocean simulations and high-performance computing capabilities. COSIM ocean simulations have demonstrated dramatic improvement in the representation of ocean circulation, including realistic representations of the North Atlantic current system and Gulf Stream separation. Past high-resolution simulations have focused on the ocean, but COSIM team members are in the process of performing such simulations in a fully coupled climate model with eddy-resolving ocean and sea ice components joined together with high-resolution atmosphere and land models.



Over the next few years, polar climate change and its global impacts will be an important emphasis as polar regions experience the largest response to climate change. Evaluating the possibility of ice sheet collapse, simulating the observed rapid Arctic sea ice melt, expanding the representation of polar ecosystems to include ice organisms, identifying thresholds of ocean circulation stability resulting from large freshwater inputs, and quantifying the magnitude and rate of sea level rise will all be important areas of research as we assess the impacts of climate change.



*Fig. 2. Concentration of a passive dye tracer at 317 m depth after 7 months of simulation. This tracer has arbitrary units and its concentration is continuously reset to be 1 in the top level.*

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#### **Funding Acknowledgments**

- Department of Energy, Office of Biological and Environmental Research, Climate Change Prediction Program
- Department of Energy, Office of Science, Scientific Discovery through Advanced Computing Program